Nowcasting of convection initiation by analysis and fusion of multiple data sources

Dennis Stich[1], Caroline Forster[1], George Craig[2], Arnold Tafferner[1], and Tobias Zinner[2]

EUMETSAT Meteorological Satellite Conference

Cordoba, Spain, 20 – 24 September 2010

1 DLR Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
2 Meteorological Institute, University of Munich, Germany

Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Outline

Motivation

Cb-TRAM (**C**umulonim**b**us **TR**acking **A**nd **M**onitoring)

CI- Verification

Next steps

Summary

Motivation

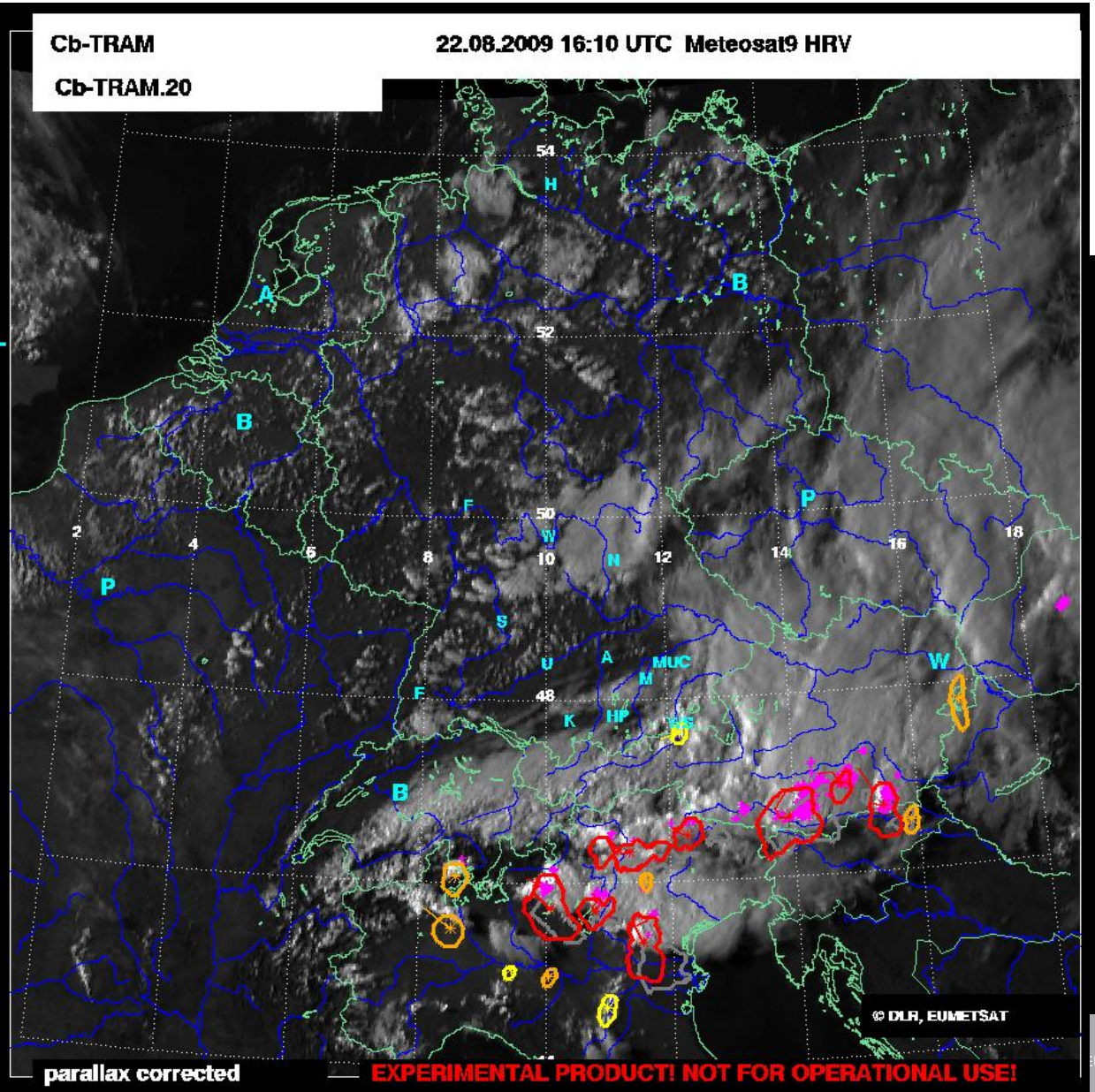
Aviation purposes

Lead time: satellite vs radar

Cb-TRAM as basic tool

Adding non-satellite fields for further developement

Cb-TRAM - Cumulonimbus TRacking And Monitoring



Used MSG rapidscan data:

WV 6.2	IR 10.8
IR 12.0	HRV

Detection stages:

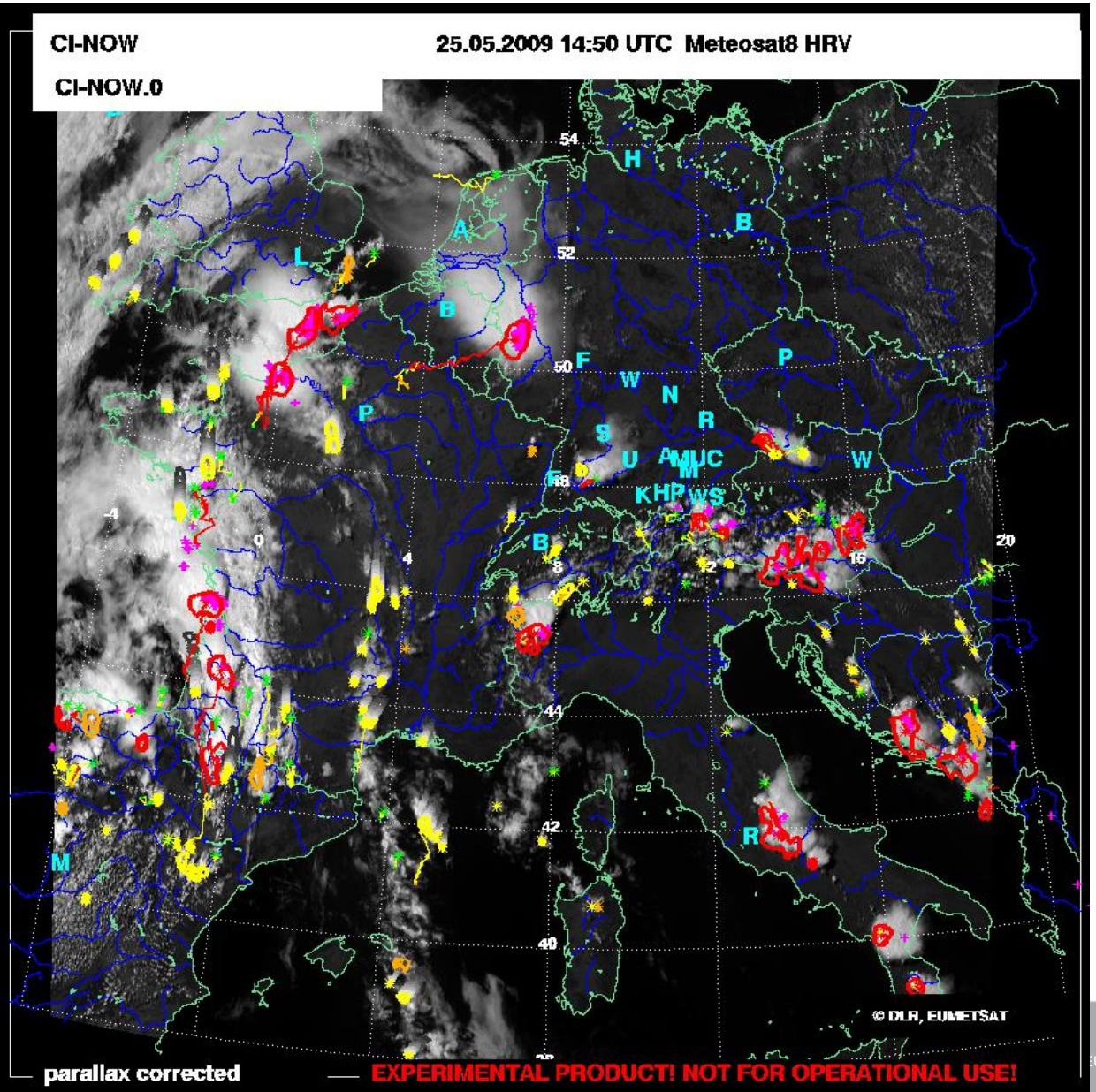
1: Convection Initiation (CI)
- development in HRV
- IR 10.8 cooling

2: Rapid development
- WV 6.2 rapid cooling (> 1K/15min)

3: Mature storms
- T 6.2 - T 10.8
- HRV texture

Lightning

Cb-TRAM - Cumulonimbus TRacking And Monitoring



Tracks:

Colors represent the different detection stages within the track

Description: Zinner et al., 2008

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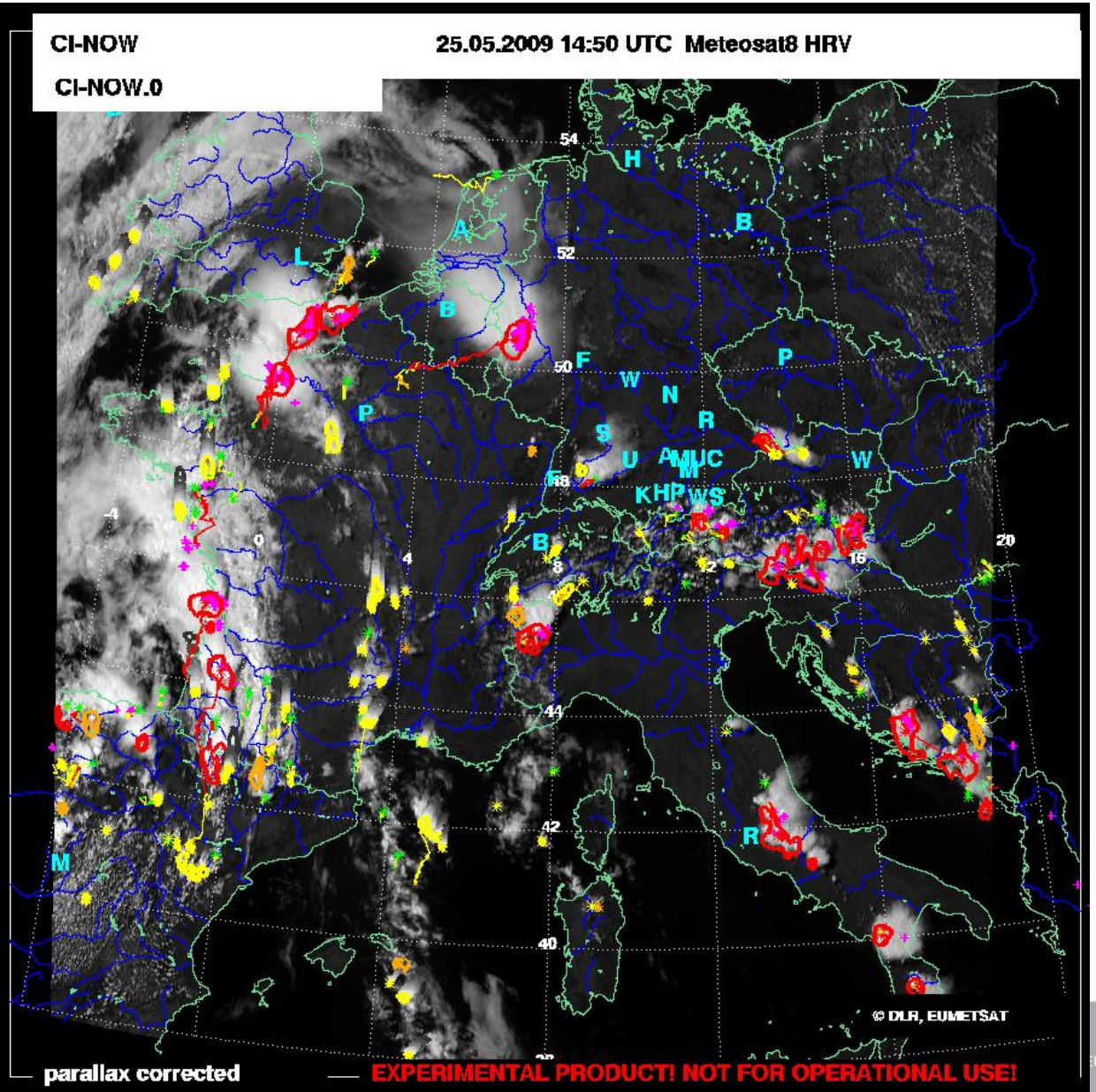

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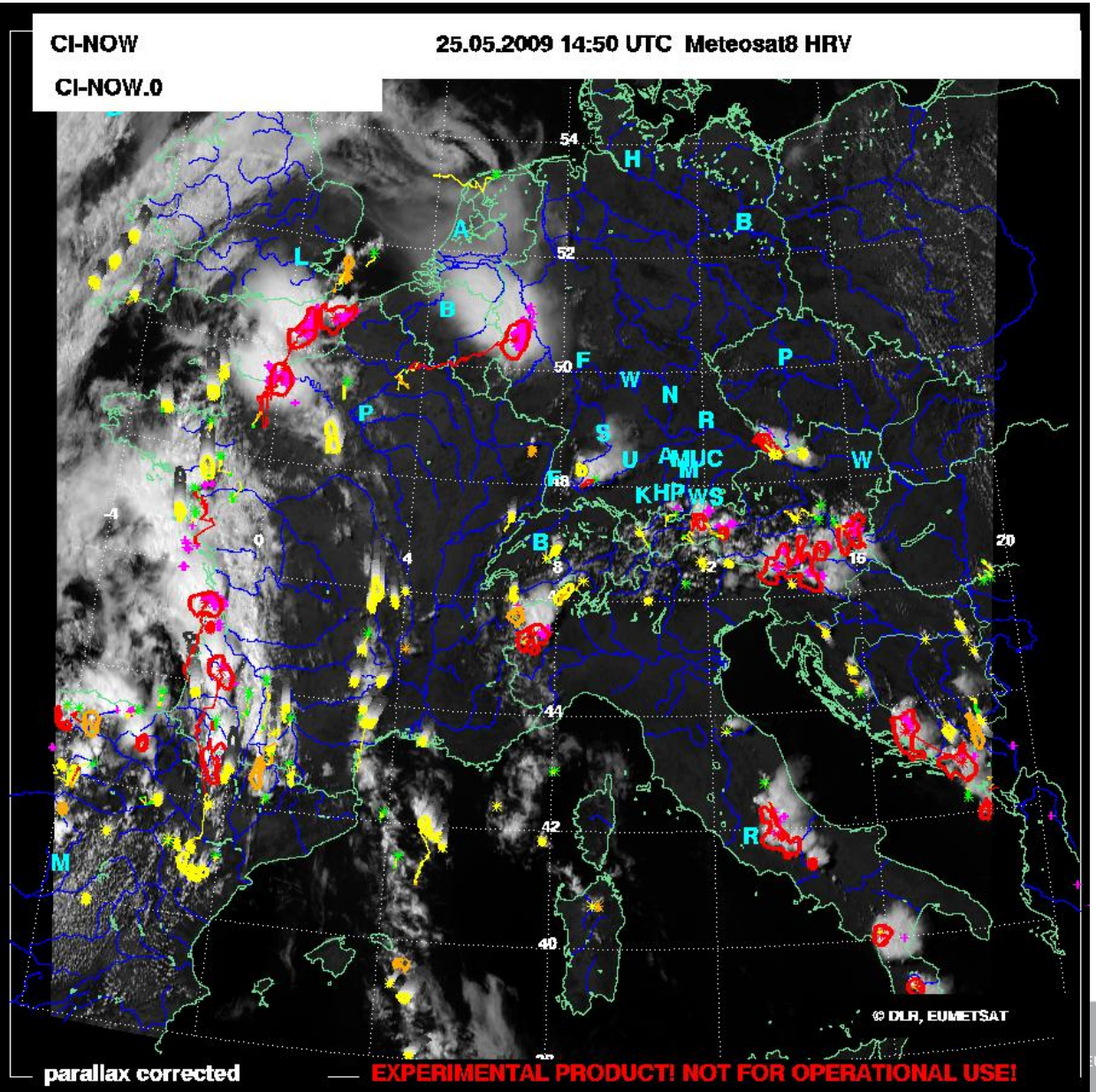

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Posttracking:

The green stars monitor positions of cells detected within the last two timesteps but not at the current one

Description: Zinner et al., 2008

CI-Verification

How to verifiy CI?

Cutting edge of forecast verification!

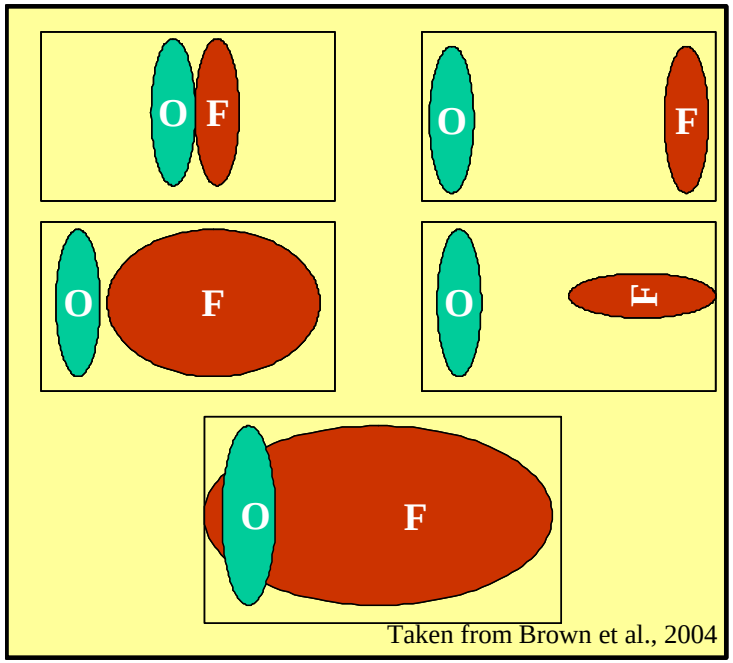
Difficult to match CI satellite indicators to lateron (30 – 60 min) existing storms, detected in radar, lightning or satellite data

Thunderstorms are relatively rare events!

How to deal with close nowcasts? What is close?

Contingency tables

		Observed	
		yes	no
Forecast	yes	hit	false alarm
	no	miss	correct negative



Taken from Brown et al., 2004

CI-Verification

How is a “CI-event“ defined? Or: What‘s used as “truth“?

- radar echo ≥ 35 dBZ
  (e.g. Roberts & Rutledge, 2003; Mecikalski & Bedka, 2006)

- Lightning density / flash rate
  (e.g. Zinner & Betz, 2009; Donovan et al., 2008)

- Cb-TRAM “mature storm“-stage
  determined by IR 6.2 – IR 10.8 and HRV texture

CI-Verification

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Cb-TRAM stage 1, 2, and 3 analysis used for comparison with the 15, 30, 45, and 60 minutes CI-stage nowcast

- Cb-TRAM “mature storm“-stage
  determined by IR 6.2 – IR 10.8 and HRV texture

CI-Verification

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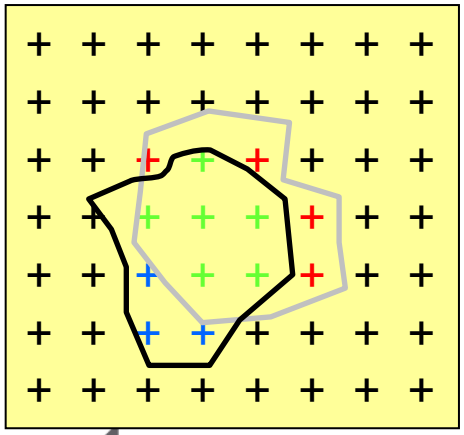

Pixel based

Requires perfect matching!

CI-Verification

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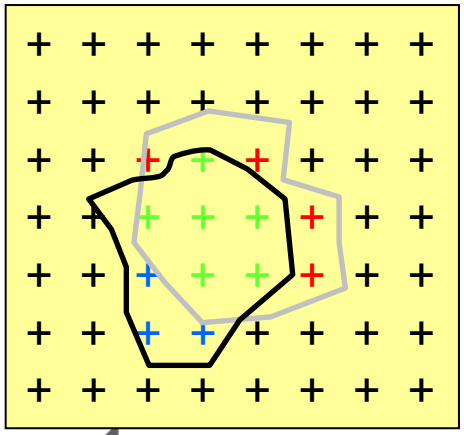

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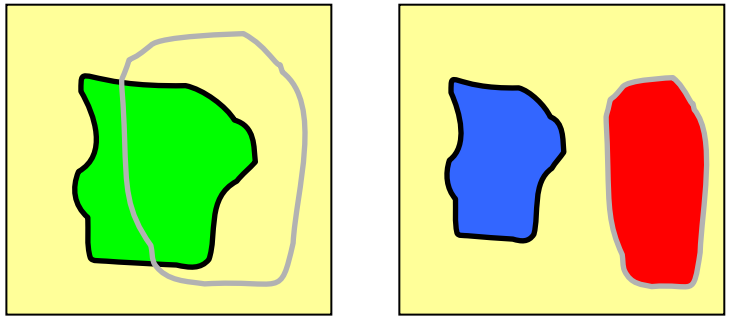
Object based



double penalty problem

CI-Verification

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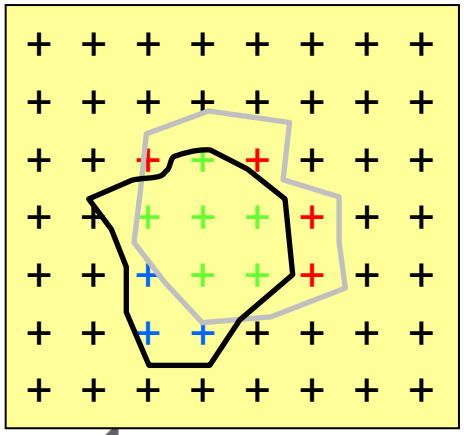

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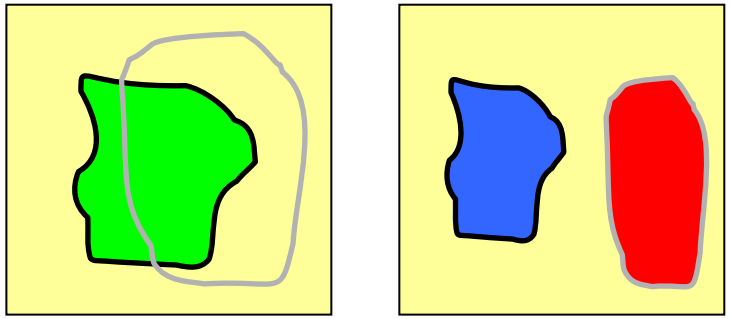
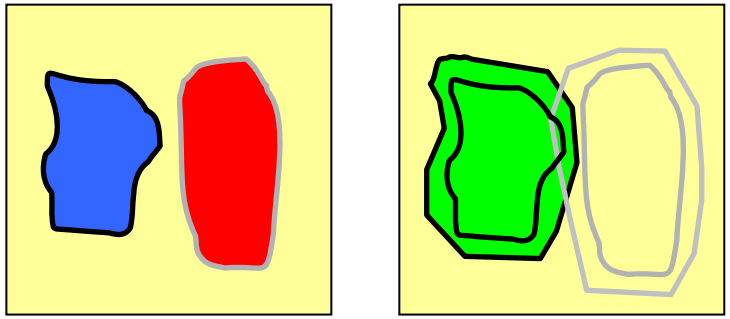


double penalty problem

Fuzzy + Object based



CI-Verification

Different versions:

Pixel based

& with Cb stage 2 nowcasts

Object based

& with Cb stage 2 nowcasts

Future work:

Fuzzy + Object based

incorporating

tracking uncertainties

Preliminary results for the summer 2009, 15 May to 31 August (30 minute nowcasts)			
	POD	FAR	CSI
Pixel based	0.052	0.723	0.032
Pixel based Nowcast1&2	0.084	0.798	0.048
Object based	0.133	0.703	0.090
Object based Nowcast1&2	0.206	0.723	0.128

POD = hits / (hits + misses)
FAR = false alarms / (hits + false alarms)
CSI = hits / (hits + misses + false alarms)

Next steps

Incorporating some more satellite “interest fields“ using existing channels

Testing the additional information provided by:

- Satellite channels
- VERA data (e.g. moisture con- and divergence)
- COSMO-DE data (CAPE, CIN, etc)

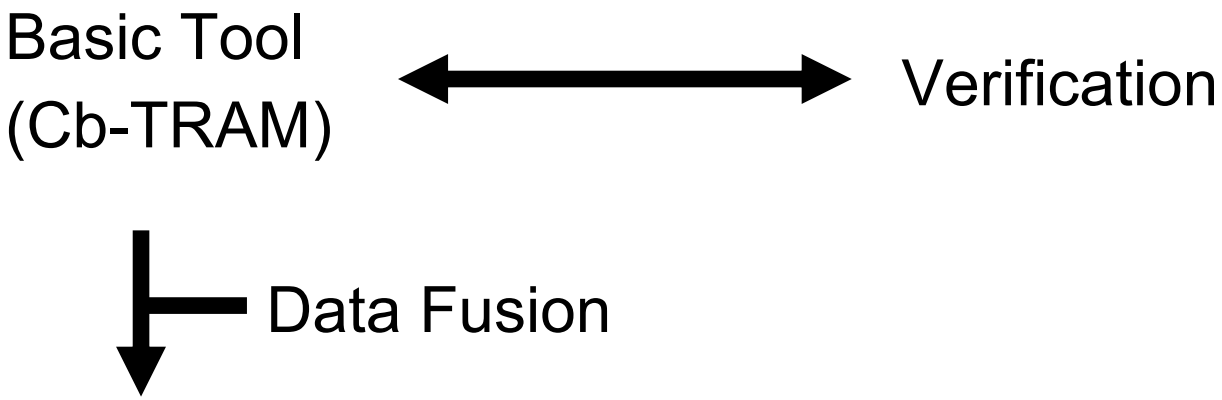
Data fusion (e.g. fuzzy logic)

Verify the abilities for the different products and their fusion

Summary

Basic Tool (Cb-TRAM)  Verification

Summary



Summary

Basic Tool (Cb-TRAM) ⟷ Verification

↓ Data Fusion

Cb-TRAM + Additional data ⟷ Verification

Summary

Basic Tool (Cb-TRAM) ⟷ Verification

↓ Data Fusion

Cb-TRAM + Additional data ⟷ Verification

↓

CI-NOW – a CI detection and nowcasting tool

References

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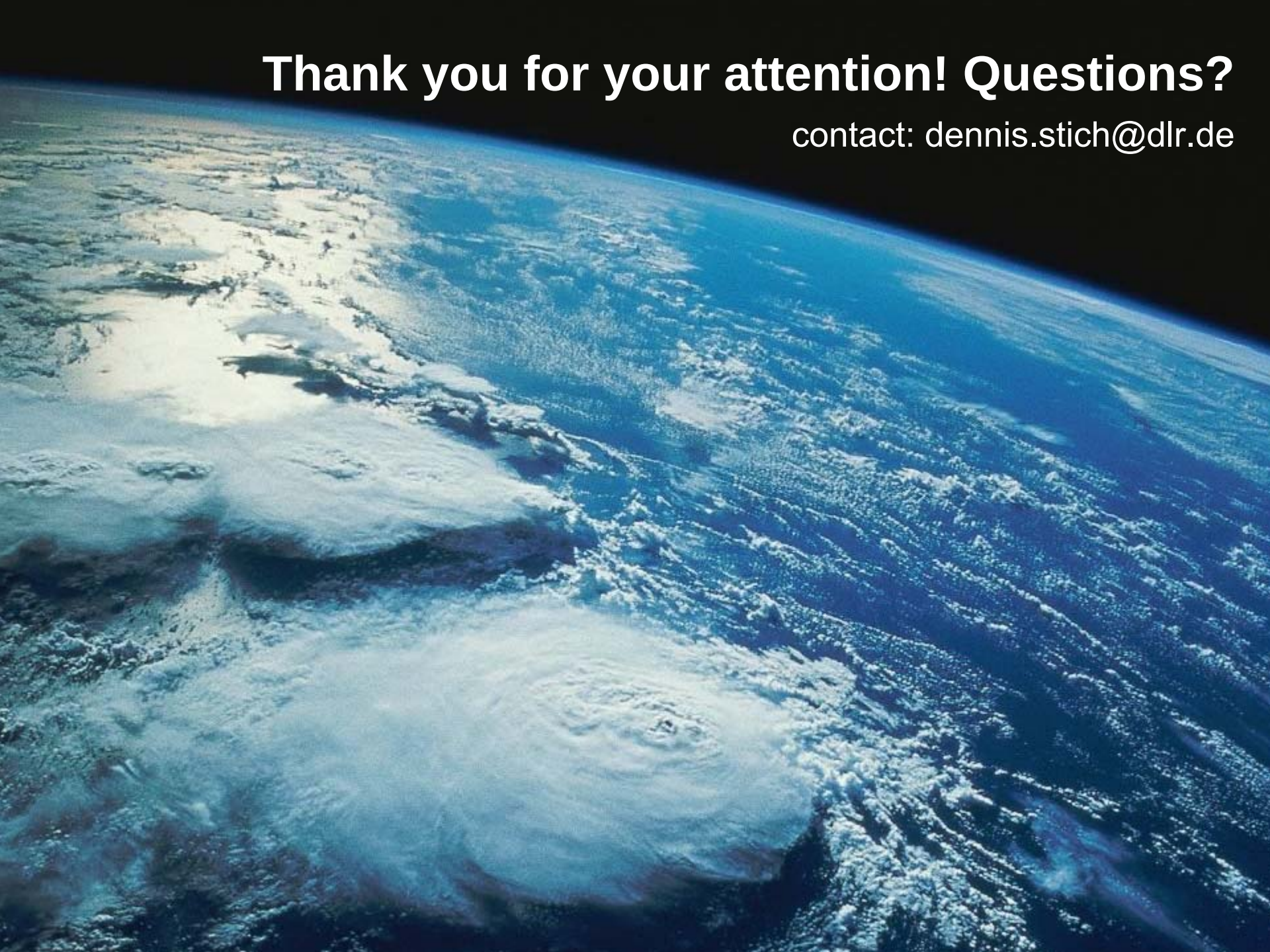

Thank you for your attention! Questions?

contact: dennis.stich@dlr.de